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(54) Chip antenna

(57) An antenna device (1) is provided in which deterioration of characteristics is prevented and which has improved strength. A chip antenna (2) is inserted into a resin case (11) serving as a support member, and one terminal (21) of the resin case (11) is bonded to a power feeding terminal (9) and another terminal (21) of the case (11) is bonded to a fixation terminal (22) of the chip antenna (2) by solder (14). The chip antenna (2) is fixed to the resin case (11) so that a gap (13) is provided between the printed circuit board (12) on which the chip antenna (2) is mounted and the chip antenna (2). Then, by bonding the terminals (21) of the resin case (11) to the printed circuit board (12) by solder (14), the chip antenna (2) is mounted on the printed circuit board (12).

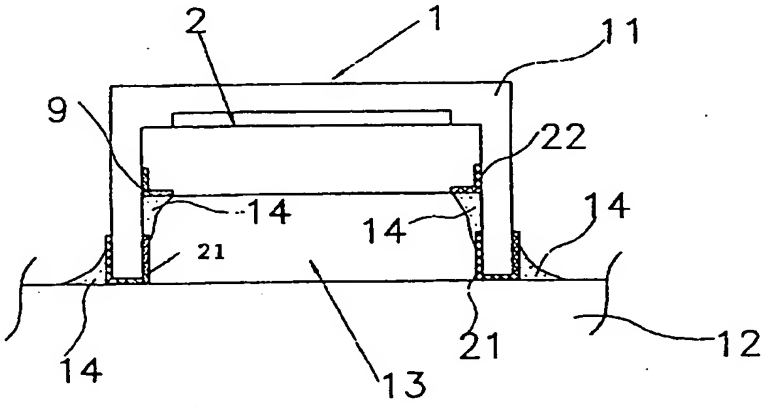

FIG. 1B

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an antenna device and, more particularly, to an antenna device for use in mobile communications and local area networks (LAN).

2. Description of the Related Art

A conventional antenna device will now be described with reference to Fig. 6. A chip antenna 90 comprises an insulator layer 91, a laminated coil 92 in the shape of a flat plate, a magnetic-component layer 93, and an external connection terminal 94. This chip antenna 90 is mounted on a printed circuit board 95 and is connected by solder 96, and thus a conventional antenna device is formed.

However, the above-described conventional antenna device has problems, for example, since the chip antenna is directly mounted on a printed circuit board, its flexibility and drop strength are small, and since the printed circuit board and the chip antenna are in contact with each other, the chip antenna is likely to be influenced by the ground electrode on the printed circuit board, causing its characteristics to change from the required characteristics.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide an antenna device in which deterioration of characteristics is prevented and which has improved strength.

To achieve the above-described object, according to the present invention, there is provided an antenna device, comprising: a chip antenna comprising a base; a conductor disposed on at least one of a surface of the base and inside the base, a power feeding terminal provided on the surface of the base for applying a voltage to the conductor; and a support member for mounting the chip antenna on a mounting board, the chip antenna being mounted on the mounting board by the support member with a gap between the chip antenna and the mounting board.

Because of this construction, a gap is formed between the chip antenna and the mounting board on which the chip antenna is mounted by using the support member. Thus, the distance between the chip antenna and the ground electrode on the mounting board is large, making it possible to prevent the characteristics of the antenna from deteriorating.

Further, since the chip antenna is mounted on the mounting board in such a manner as to be held and fixed thereto by a support member, the flexibility and drop strength can be increased.

The above and further objects, aspects and novel features of the invention will become more apparent from the following detailed description when read in connection with the accompanying drawings.

Other features and advantages of the present invention will become apparent from the following description of the invention which refers to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1A is an illustration of an antenna device according to a first embodiment of the present invention;

Fig. 1A(a) is an illustration of the chip antenna disposed inside the antenna device of Fig. 1A;

Figs. 1B is a sectional view of the antenna device taken along the line A-A according to the first embodiment of the present invention;

Fig. 2 is a perspective view illustrating a chip antenna structure according to the present invention;

Fig. 3 is an exploded perspective view of the assembly of a dielectric base which constitutes the chip antenna of Fig. 1;

Figs. 4A, 4B and 4C are sectional views illustrating an antenna device according to other embodiments of the present invention;

Figs. 5A and 5B are sectional views illustrating an antenna device according to still yet other embodiments of the present invention; and

Fig. 6 is a sectional view illustrating a conventional antenna device.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

The preferred embodiments of an antenna device of the present invention will be described below with reference to the accompanying drawings.

As shown in Figs. 1A and 1A(a), a chip antenna 2 is disposed in a resin case 11 serving as a support member. As shown in Fig. 1B, a terminal 21 of the resin case 11 is bonded to a power feeding terminal 9 and another terminal 21 is bonded to a fixation terminal 22 of the chip antenna 2 by means of, for example, solder 14. In such a case, the chip antenna 2 is supported in the resin case 11 in order that a gap 13 is provided between a printed circuit board 12 for mounting the chip antenna 2 and the chip antenna 2. Then, the chip antenna 2 is mounted on the printed circuit board 12 by bonding terminal 21 of the resin case 11 to the printed circuit board 12 by the solder 14, and thus an antenna device 1 is

formed.

The construction of the chip antenna will be described below with reference to Figs. 2 and 3.

The antenna device 1 comprises a conductor 5 which is wound around a base 4 in a spiral along the length thereof (in the direction of the arrow L in Fig. 2) inside the base 4 in the shape of a rectangular parallelopiped formed from a dielectric material. The base 4, as shown in Fig. 3, comprises a lamination of dielectric sheets 6a, 6b and 6c in the shape of a rectangle made of a ceramic of mixed components having barium oxide, aluminum oxide and silica as main constituents, or mixed components of a ceramic and a resin. Provided on the dielectric sheets 6b and 6c from among the sheets are conductive patterns 7a to 7h substantially in the shape of a straight line made of copper, a copper alloy or the like by a method, such as printing, vapor deposition, pasting, or plating, etc., and through hole conductors 8 are provided on the dielectric sheet 6b by filling the through hole formed along the width thereof with a conductor. Then, the dielectric sheets 6a and 6c are laminated, and the conductive patterns 7a to 7h are connected via the through hole conductors 8. Thus, a conductor 5 in the shape of a spiral whose cross section is rectangular is windingly formed along the length (in the direction of the arrow L in Fig. 2) of the base 4. Further, one end (one end of the conductive pattern 7e) of the conductor 5 is extended onto a surface of the base 4 and formed on a surface of the base 4, further forming a power feeding terminal 3 which is connected to the power feeding terminal 9 for applying a voltage to the conductor 5. The other end (one end of the conductive pattern 7d) of the conductor 5 forms a free end 10 inside the base 4. Then, the power feeding terminal 9 to which the power feeding terminal 3 of the conductor 5 is connected is formed on one side of the base 4, and the fixation terminal 22 for holding and fixing the chip antenna 2 to the support member is formed on the other side of the base 4, and thus the chip antenna 2 is formed. The power feeding terminal 9 serves also as a fixation terminal.

By holding and fixing the chip antenna 2 in the resin case 11 as described above, the flexibility and drop strength are increased. Further, by providing the gap 13 between the chip antenna 2 and the printed circuit board 12, it is possible to prevent the characteristics of the chip antenna from deteriorating or changing.

Also, as shown in Figs. 4A, 4B and 4C, a J-bend 15 may be used as a support member. The shape of the J-bend may be those shapes shown in Figs. 4A to 4C, and can be changed in various ways according to uses of the chip antenna.

Further, in order to provide support for the chip antenna 2 and provide a convenient point for soldering, the support members 15 have ledges 15A provided thereon.

Further, as shown in Figs. 5A and 5B, the chip antenna 2 may be mounted on the printed circuit board 12 in such a manner as to be vertically fixed to the fixation member. By vertically mounting the chip antenna 2 on the printed circuit board 12 in this way, the chip antenna 2 is less likely to be affected by the ground electrode on the printed circuit board 12, and therefore, it is possible to prevent the characteristics of the chip antenna from deteriorating.

In the above-described chip antenna, the winding shape of the conductor is not limited to the shape of a square or rectangle, but may be a circular shape or substantially an oval shape having a straight line in a part thereof, or a substantially semicircular shape, and the conductor may be formed on the surface of the dielectric base. Although the dielectric base is preferably formed by laminating a plurality of dielectric base layers, the dielectric base may be formed from, for example, a single, unlaminated dielectric block. Further, the material of the base is not limited to a dielectric material. Even if, for example, a base formed by using a magnetic material having ferrite formed from Ni, Co or Fe as main constituents or a base formed by combining a dielectric material and a magnetic material is used, advantages comparable to the case in which a dielectric material is used can be obtained. Further, the shape of the base is not limited to a rectangular parallelopiped shape, but may be changed as required, for example, to a polyhedron-type shape, a barrel-type shape, or a circular cylinder-type shape.

In the antenna device of the present invention, as described above, when a chip antenna is mounted, a gap is formed between the chip antenna and a base for mounting the chip antenna by using a support member. Thus, the distance between the chip antenna and a ground electrode on the base is large, and it becomes possible to prevent the characteristics of the antenna from deteriorating or changing. In addition, since the chip antenna is mounted on the base in such a manner as to be held and fixed by the support member, it becomes possible to increase the flexibility and the drop strength by holding and fixing the chip antenna onto the base by means of a support member.

Many different embodiments of the present invention may be constructed without departing from the spirit and scope of the present invention. It should be understood that the present invention is not limited to the specific embodiments described in this specification. To the contrary, the present invention is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the invention as hereafter claimed. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications, equivalent structures and functions.

Claims

1. An antenna device (1), comprising:

   a chip antenna (2) comprising:

a base (4);

a conductor (5) disposed on at least one of a surface of the base (4) and inside said base (4);

a power feeding terminal (9) provided on the surface of said base (4) for applying a voltage to said conductor (5); and

a support member (11; 15) for mounting said chip antenna (2) on a mounting board (12), said chip antenna (2) being mounted on said mounting board (12) by said support member (11; 15) with a gap (13) between the chip antenna (2) and the mounting board (12).

2. The antenna device (1) of claim 1, wherein the support member (11) comprises a case enclosing the chip antenna (2) and receiving the chip antenna (2) in an inner recess of the case, the recess being open on one side facing the mounting board (12), the chip antenna (2) being disposed in the recess so that the chip antenna (2) is held at a distance from the mounting board defining said gap (13).

3. The antenna device (1) of claim 1 or 2, wherein the support member (11) comprises a power feeding terminal (21) coupled to the power feeding terminal (9) on the base (4) and a fixation terminal (21) coupled to a fixation terminal (22) on the base (4).

4. The antenna device (1) of claim 1, wherein the support member (15) comprises respective conducting extending members engaging the base (4) and electrically connected respectively with the power feeding terminal (9) on the base (4) and a fixation terminal on the base (4).

5. The antenna device (1) of claim 4, wherein the extending members (15A) each have a flared end for fixation onto the mounting board (12).

6. The antenna device (1) of claim 4 or 5, wherein the extending members each have a ledge (15A) for supporting the chip antenna (2) at a distance from the mounting board (12) defining said gap (13).

7. The antenna device (1) of claim 5 or 6, wherein the extending members are flared inwardly.

8. The antenna device (1) of claim 5 or 6, wherein the extending members are flared outwardly.

9. The antenna device (1) according to any of the preceding claims, wherein the chip antenna (2) has a broad surface, the broad surface being disposed coplanar with the mounting board (12).

10. The antenna device (1) according to any of the claims 1 to 8, wherein the chip antenna (2) has a broad surface, the broad surface being disposed perpendicular to the mounting board (12).

11. The antenna device (1) according to any of the preceding claims, wherein the base (4) comprises a plurality of laminated layers (6b, 6c), each having a portion of the conductor (7a to 7h) disposed thereon, at least one through hole (8) being provided on at least one of said layers (6b) for interconnecting the portions of the conductor (5) to form said conductor (5).

12. The antenna device (1) according to any of the claims 1 to 10, wherein the base comprises a unitary block of material.

13. The antenna device (1) according to any of the preceding claims, wherein the base comprises one of a dielectric material, a magnetic material or a combination of a magnetic material and a dielectric material.

14. The antenna device (1) according to any of the preceding claims, wherein the conductor (5) is spiral shaped.

15. The antenna device of claim 14, wherein the conductor (5) is one of square, rectangular, circular, oval having a straight line in part and substantially semicircular in cross-section.

16. The antenna device 1 according to any of the preceding claims, wherein the base (4) is one of a rectangular parallelopiped, a cube, a polyhedron, barrel shaped and cylinder shaped.

17. The antenna device (1) according to any of the preceding claims, wherein the support member (11; 15) increases flexibility and drop strength of the antenna device (1).

18. The antenna device (1) according to any of the preceding claims, wherein the gap (13) reduces influence of a ground electrode on the mounting board (12) on the antenna device (1).

19. The antenna device (1) of claim 2, wherein the case (11) comprises a resin case.

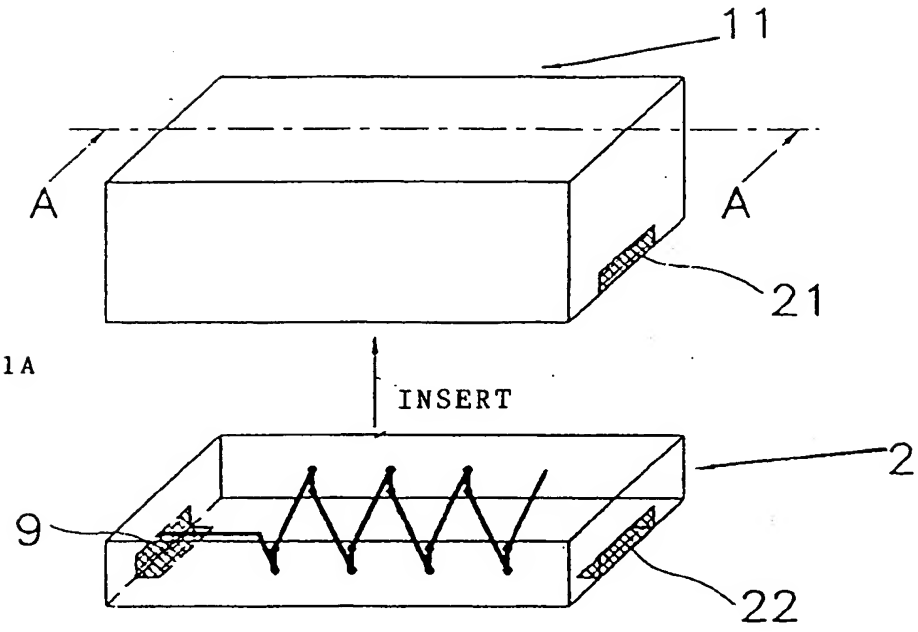

FIG. 1A

FIG. 1A(a)

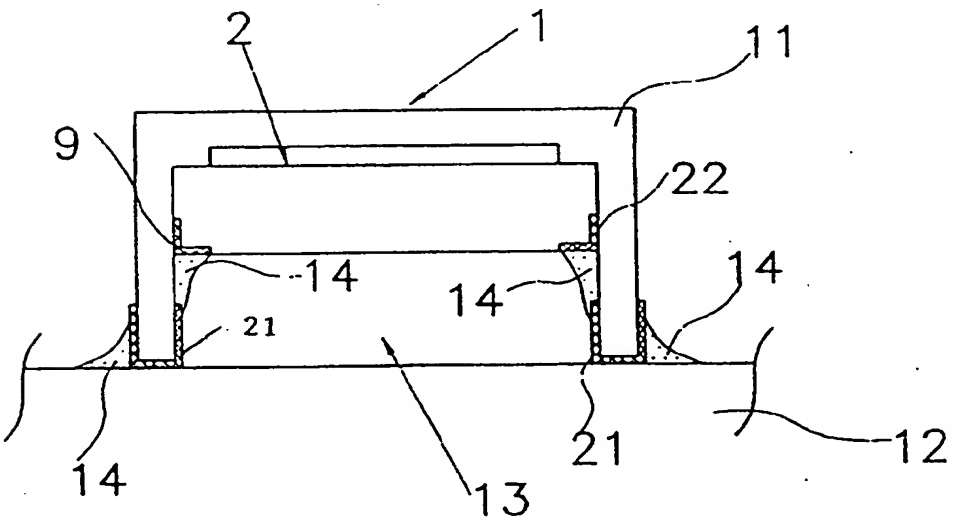

FIG. 1B

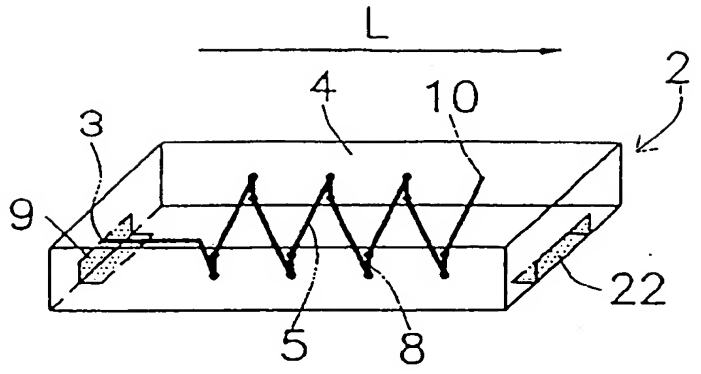

FIG. 2

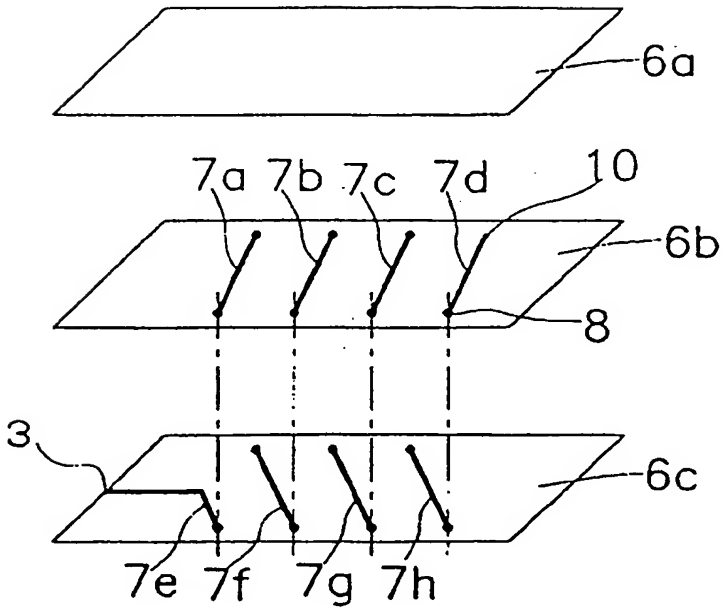

FIG. 3

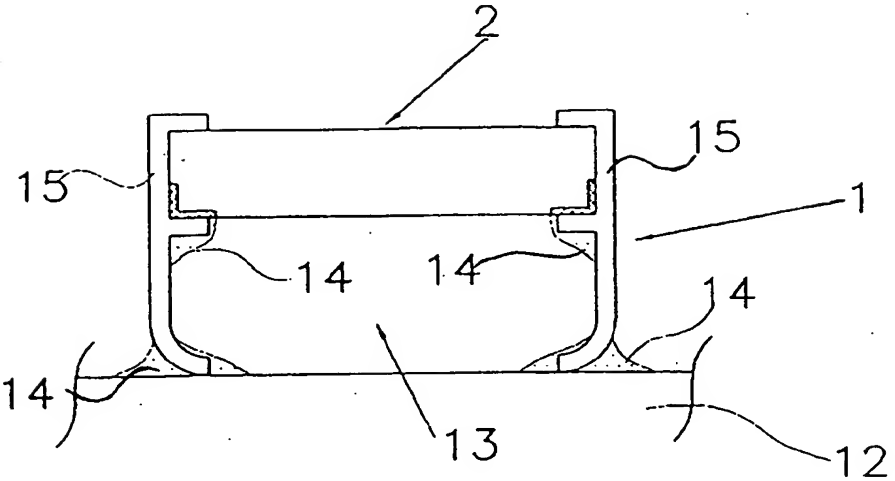

FIG. 4A

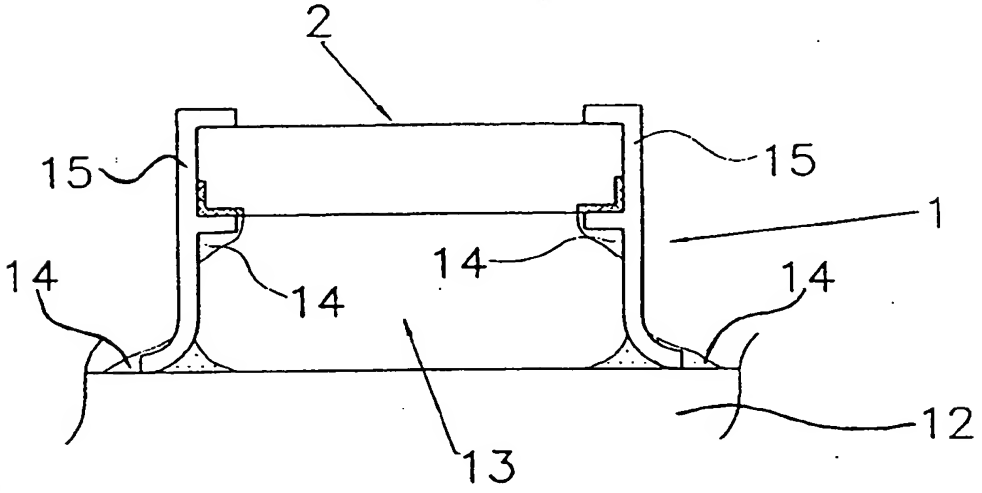

FIG. 4B

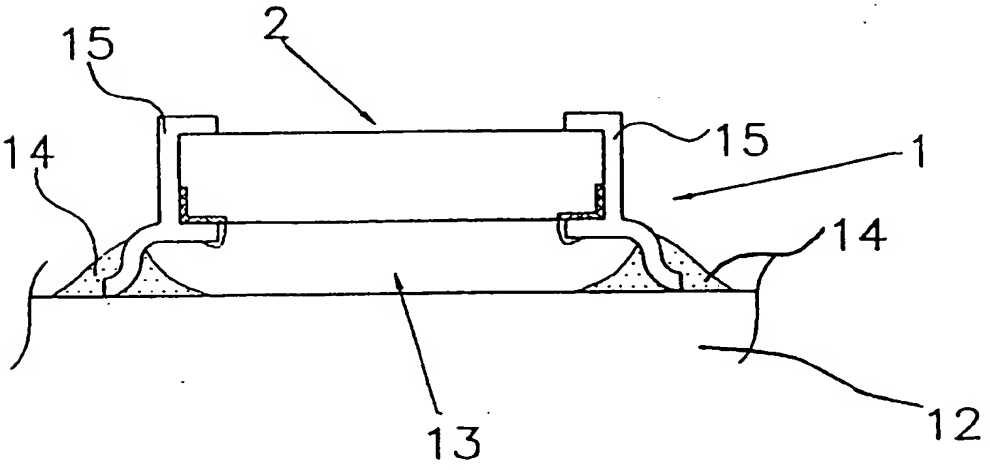

FIG. 4C

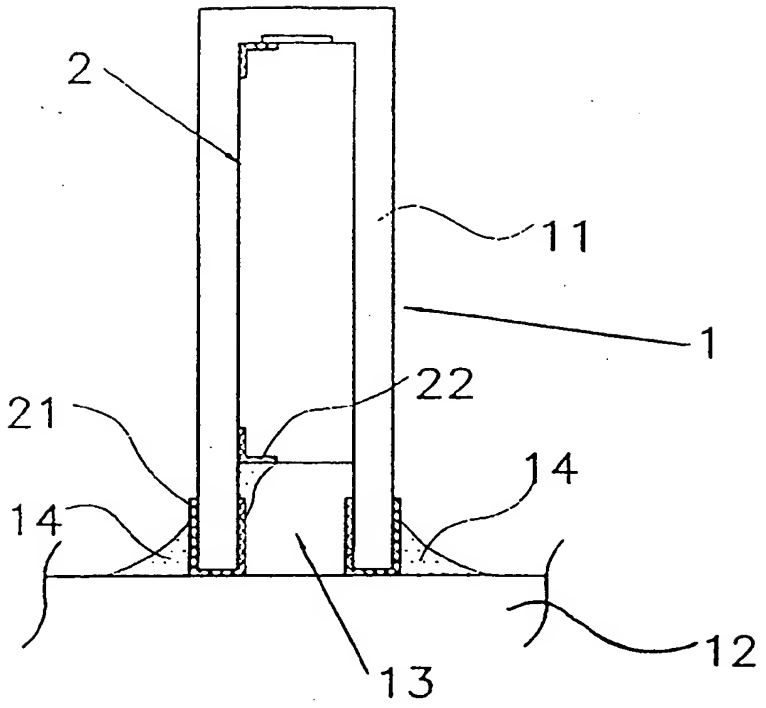

FIG. 5A

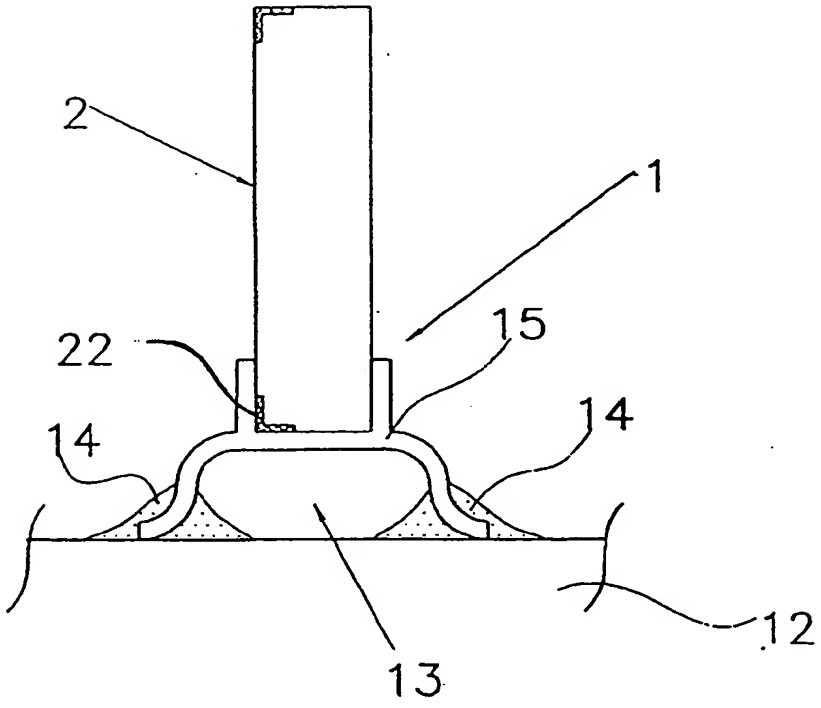

FIG. 5B

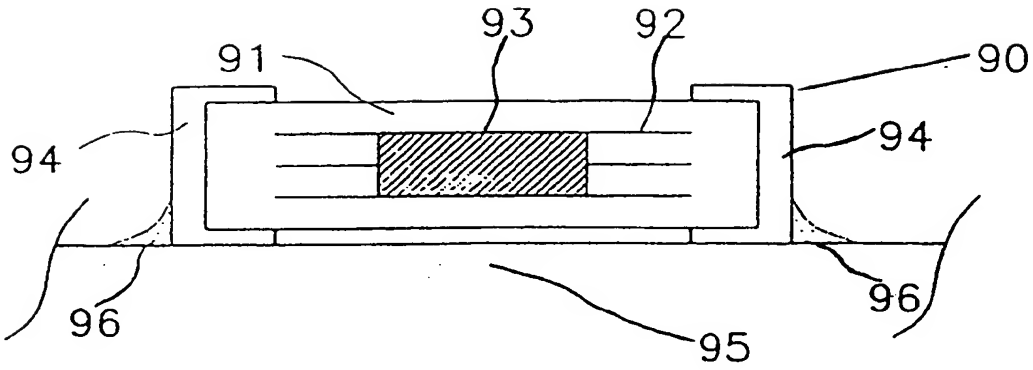

FIG. 6

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(54) Chip antenna

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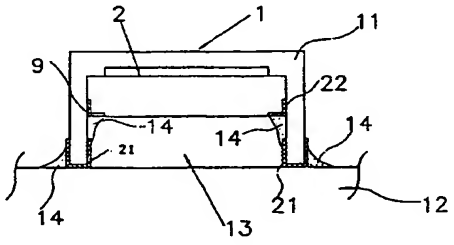

FIG. 1B

EP 0 762 536 A3

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EUROPEAN SEARCH REPORT

Application Number
EP 96 11 4259

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	EP-A-0 621 653 (MURATA MANUFACTURING CO) 26 October 1994 * column 11, line 17 - column 13, line 2; figure 8 *	1,2	H01Q9/04
A	US-A-5 014 071 (KING JEFFREY S) 7 May 1991 * column 3, line 1 - column 3, line 18; figures 1-3 *	1-19	
P,A	EP-A-0 687 030 (MURATA MANUFACTURING CO) 13 December 1995 * column 10, line 14 - column 10, line 34; figure 8 *	1-19	
P,A	PATENT ABSTRACTS OF JAPAN vol. 95, no. 010 & JP-A-07 288422 (MURATA MFG CO LTD), 31 October 1995, * abstract *	1-19	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

H01Q

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	10 February 1997	VILLAFUERTE ABR.., L

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